

CLAIMS

1. An apparatus for creating a pattern on a workpiece sensitive to light radiation, such as a photomask a display panel or a microoptical device,
5 comprising
a source for emitting light in the wavelength range from EUV to IR,
a spatial light modulator (SLM) having a multitude of modulating elements (pixels), adapted to being
10 illuminated by said radiation
a projection system creating an image of the modulator on the workpiece,
an electronic data processing and delivery system receiving a digital description of the pattern to be
15 written, converting said pattern to modulator signals, and feeding said signals to the modulator,
a precision mechanical system for positioning said workpiece and/or projection system relative to each other,
20 an electronic control system controlling the position of the workpiece, the feeding of the signals to the modulator and the intensity of the radiation, so that said pattern is printed on the workpiece, and
means for rotating the coordinate system of the pattern
25 to be created.
2. An apparatus according to claim 1, wherein the means for rotating the coordinate system of the pattern to be written comprises means for rotating the modulator.
3. An apparatus according to claim 1, wherein the
30 means for rotating the coordinate system of the pattern to be written comprises an optical element for rotating the image projected from the modulator to the workpiece.
4. An apparatus according to claim 2, wherein said optical element is a Dove prism.

5. An apparatus according to claim 2, wherein said optical element is an analog arrangement of reflecting surfaces.

6. An apparatus according to claim 1, wherein the means for rotating the coordinate system of the pattern to be written comprises means for imposing a rotation to the digital description supplied to the electronic data processing and delivery system.

7. An apparatus according to claim 1, wherein the means for rotating the coordinate system of the pattern to be written comprises means for imposing a rotation to the modulator signals supplied by the electronic data processing and delivery system.

8. An apparatus according to claim 1, wherein it further comprises a detection system for detecting a rotational deviation between an already existing pattern on the workpiece and the pattern to be created, said means for rotating the coordinate system of the pattern to be created being operable to diminish said rotational deviation.

9. An apparatus according to claim 8, wherein the detection system comprises means for detecting the position of at least one alignment mark on the workpiece.

10. An apparatus according to claim 9, wherein the means for detecting the at least one alignment mark comprises a light source for emitting a detection light to be reflected on the workpiece, and at least one detector for analyzing the reflected light.

11. An apparatus according to claim 10, wherein the detection light is of wavelength to which the workpiece is not sensitive.

12. An apparatus according to claim 10, wherein the detection light at least partly is projected on the workpiece in the same beam path as the writing beam for creation of the pattern.

- 5 13. An apparatus according to claim 12, wherein it further comprises a field restriction, whereby the detection light only uses a part of the available exposure field.

- 10 14. An apparatus according to claim 13, whereby the field restriction imposes a reduction of at least 80% of the available exposure field.

15. An apparatus according to claim 12 or 13, whereby the field restriction comprises a modulator.

- 15 16. An apparatus according to claim 12 or 13, whereby the field restriction comprises a small angle scanner.

17. An apparatus according to claim 8, wherein it further comprises means for measuring a positioning offset for the writing beam relative to the workpiece.

- 20 18. An apparatus according to claim 17, wherein the means for measuring a positioning offset for the writing beam comprises means for detecting the position of at least one measuring mark on the workpiece and comparing it to a pre-stored position for said mark.

- 25 19. An apparatus according to claim 18, wherein the means for detecting the at least one measuring mark comprises a light source for emitting a detection light to be reflected on the workpiece, and at least one detector for analyzing the reflected light.

- 30 20. A method for creating a microlithographic second pattern on a workpiece sensitive to radiation, said workpiece already comprising a first written

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pattern, comprising the steps of:

- detecting a rotational deviation between the already existing pattern on the workpiece and the second pattern to be created,
- 5 illuminating a light modulator, with electromagnetic radiation in the wavelength range from EUV to IR, projecting an image of the modulator on the workpiece, moving said workpiece and/or projection system relative to each other,
- 10 further reading from an information storage device a digital description of the pattern to be written, converting said digital description to modulator signals, and feeding said signals to the modulator, and imposing a rotation to the coordinate system of the
- 15 second pattern to be written to diminish said rotational deviation.
21. The method according to claim 20, wherein the rotation of the coordinate system of the second pattern to be written is imposed by rotation of the modulator.
- 20 22. The method according to claim 20, wherein the rotation of the coordinate system of the second pattern to be written is imposed by optical rotation of the image projected from the modulator to the workpiece.
- 25 23. The method according to claim 20, wherein the rotation of the coordinate system of the second pattern to be written is imposed by a rotation conversion of the digital description supplied to the electronic data processing and delivery system.
- 30 24. The method according to claim 20, wherein the rotation of the coordinate system of the second pattern to be written is imposed by a rotation conversion of the modulator signals.
25. An apparatus for creating a pattern on a workpiece sensitive to light radiation, such as a

photomask a display panel or a microoptical device,
comprising

a source for emitting a light beam in the wavelength
range from EUV to IR,

- 5 a computer-controlled light modulator controlled
according to input pattern data,

a projection system creating an image of the modulator
on the workpiece,

- an electronic data processing and delivery system
10 receiving a digital description of the pattern to be
written, converting said pattern to modulator signals,
and feeding said signals to the modulator,

a precision mechanical system for positioning said
workpiece and/or projection system relative to each

- 15 other,

a deflector for scanning of the least one beam across a
region of the surface of the workpiece,

- an electronic control system controlling the position
of the workpiece, the feeding of the signals to the
20 modulator and the intensity of the radiation and the
deflector, so that said pattern is printed on the
workpiece, and

means for rotating the coordinate system of the pattern
to be created.

- 25 26. An apparatus according to claim 25, wherein the
deflector is an accusto-optic deflector.

27. An apparatus according to claim 26, wherein the
means for rotating the coordinate system of the pattern
to be written comprises means for rotating the deflector.

- 30 28. An apparatus for creating a pattern on a
workpiece sensitive to light radiation, such as a
photomask a display panel or a microoptical device,
comprising
a source for emitting light in the wavelength range
35 from EUV to IR,

a modulator, adapted to being illuminated by said radiation

a projection system creating an image of the modulator on the workpiece,

- 5 an electronic data processing and delivery system receiving a digital description of the pattern to be written, converting said pattern to modulator signals, and feeding said signals to the modulator,

- 10 a precision mechanical system for positioning said workpiece and/or projection system relative to each other,

- an electronic control system controlling the position of the workpiece, the feeding of the signals to the modulator and the intensity of the radiation, so that
15 said pattern is printed on the workpiece, and

an alignment system for alignment of said workpiece by detection of alignment marks on the workpiece, said alignment system comprising:

- 20 a light source for emitting a detection light to be reflected on the workpiece, and at least one detector for analyzing the reflected light, wherein the detection light at least partly is projected on the workpiece in the same beam path as the writing beam for creation of the pattern.

- 25 29. An apparatus according to claim 28, wherein the projection system comprises a lens to focus the light beam from the light source before it reaches the substrate, wherein the detection light is projected on the workpiece through the same lens.

- 30 30. An apparatus according to claim 29, wherein the alignment system further comprises detectors for detecting a rotational position of the workpiece.

31. An apparatus according to claim 29, wherein the detection light is of wavelength to which the workpiece
35 is not sensitive.

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32. An apparatus according to claim 29, wherein it further comprises a field restriction, whereby the detection light only uses a part of the available exposure field in the lens.

- 5 33. An apparatus according to claim 32, whereby the field restriction imposes a reduction of at least 80% of the available exposure field.

34. An apparatus according to claim 32 or 33, whereby the field restriction comprises a second
10 modulator.

35. An apparatus according to claim 32 or 33, whereby the field restriction comprises a small angle scanner.

36. An apparatus according to claim 28, wherein the
15 modulator is a spatial light modulator (SLM) having a multitude of modulating elements (pixels).

37. An apparatus according to claim 28, wherein the apparatus is a scanning laser writer, and the modulator is an acousto-optic modulator.

- 20 38. An apparatus according to claim 28, wherein it further comprises a measuring system for measuring a positioning offset of the writing beam relative to the workpiece.

39. A method for creating a microlithographic
25 pattern on a workpiece sensitive to radiation, said workpiece comprising at least one alignment mark, comprising:

- detecting the orientation of the workpiece for use in controlling the writing process;
30 writing a pattern according to input pattern data on the workpiece, with electromagnetic radiation in the wavelength range from EUV to IR, through an optical path;

wherein the detection of the orientation comprises:

- projection of a detection light on the workpiece, said detection light at least partly being projected on the workpiece in the same optical path as used by the writing radiation for creation of the pattern;
- 5 detection of the light reflected on the workpiece; and
- analyzing the detected light for identification of said alignment mark.